MTM

THE JOURNAL OF METHODS-TIME MEASUREMENT

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Vol. I
No. 1

In This Issue . . . . .

Using MTM for Operator Training

A Summary of Short Reaches and Moves

MTM at Colleges and Universities

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

This initial issue of the Journal of Methods-Time Measurement formally introduces a publication dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.

The Journal will encompass the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal will be concerned chiefly with recent research developments both from the established research program at the University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications will be presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM will be described in the general news section.

The Association plans to publish the Journal five times annually. Sales will be made on both single copy and subscription basis.

The Editorial Staff will welcome contributions for all three sections described.

MTM

THE JOURNAL OF METHODS-TIME MEASUREMENT

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

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LETTER FROM THE PRESIDENT

On September 1, 1953 the MTM Research Program was transferred to the Engineering Research Institute of the University of Michigan, where our research work in the field of Predetermined Elemental Times and MTM will continue under the cooperative direction of the Association and the University.

The University of Michigan Engineering Research Institute is well known to hundreds of industries. Their activities and accomplishments in engineering research are of an extremely important and high order. However, the University Research Institute had not made important accomplishments in this field. Personnel of the Engineering Research Institute were unanimously enthusiastic in their desire to cooperate in this important program. The MTM Association is equally enthusiastic. We are confident that we have placed our research activity in a much more favorable environment from which, within a few years, we feel confident that great new developments in this field will be forthcoming. Let us state again that the Association recognizes that there are many areas in the field of Predetermined Elemental Times which are not complete nor thoroughly understood. It will be our purpose through research to add knowledge, in both basic and applied research, and to continuously improve this industrial engineering tool until it is so universally accepted that it will be a truly great force in eliminating controversy.

Seth L. Winslow
President, MTM Association

TECHNICAL

PRESENT STATUS OF RESEARCH

Charles B. Gordy – Professor, University of Michigan

As most of you already know, research is now being conducted at the Engineering Research Institute of the University of Michigan. As one of the persons directly involved in carrying out the Association's research, I would like to point out how, as I see it, the future research program will fare in this new situation. Physically, the facilities are greatly expanded. Not only is the research housed in large and roomy quarters, but a complete industrial engineering laboratory with its variety of equipment and extensive film library are at our disposal. In addition, stenographic service and trained graduate student help are available to expedite the handling of the time-consuming phases of our work.

However, of greater importance, though less tangible, are certain other aspects. The work is being conducted in an atmosphere congenial to research. At hand are experts in mathematics, physiology, psychology, and other related fields who can be consulted quickly and easily whenever problems arise in our work. The very fact that constant contact is being made with people interested and active in all types of research acts as a constant stimulus to our own work.

Thus, I feel that we can look forward to an ever-increasing and improving program of research with its consequent benefits in expanding the knowledge of human motions and in improving the technique of Methods-Time Measurement.

* *** *

RESEARCH PROJECTS SURVEY

During the first month of 1954, a survey was made by the Research Committee of the entire membership of the Association concerning the various areas in which future research should be conducted. It is in this manner that the Research Activity of the Association can best meet the needs and desires of the membership. The list of projects developed from this survey acts as a guide to the Research Committee as it endeavors to direct research into areas where investigation is most needed and useful. The results of this survey are presented in the following list:

* *** *

LIST OF RESEARCH PROJECTS IN ORDER OF PRIORITY

The Results of a Survey of MTM Association Members
4 February 1954

1. Effect of Weight on Moves (Now in progress)
2. Position
3. Learning Patterns - Methods Change Factor
4. Apply Pressure
5. Align
6. Mental Time
7. Eye Time - Visual Inspection
8. Grasp
9. Reaches and Moves to Concealed Locations
10. Effect of Weight on Body Motions
11. Body Motions
12. Type 2 and Type 3 Reaches and Moves
13. Turn
14. Walking
15. Cranking Motions
16. Simultaneous Motions

Since the Association exists only to serve its membership, it is only by means of such surveys as this that the Association can have a sensitive picture of membership needs. In line with this attitude, several persons have stated that such a Research Project's Survey become an annual affair. In this way, the Research Committee of the Association can have a continuing list of research projects listed, in order of priority and constantly being modified to meet any changing needs for MTM research, from which the Research staff can develop the necessary laboratory proven data upon which the MTM System depends for its support.

* *** *

SHORT REACHES AND MOVES – A SUMMARY OF THE COMPLETE REPORT

David L. Raphael

The Short Reaches and Moves Project was carried on with two objectives in mind. First, the present short distance Reach and Move MTM Data time values were to be checked and, second, performance times for Reaches and Moves at distances less than one inch were to be investigated. This last represents a distance range for which there is no present MTM data. Several revisions of the present short distance data were indicated by this study, and time values were developed for the less than one inch distance range. All of these are discussed below, along with their effects and implications to the application of Methods-Time Measurement. In addition, this investigation provided information of a more general nature as to the actual characteristics of a distance vs. time curve of a given Reach or Move.

The Characteristics of the Distance-Time Curve

This investigation first provided important general information concerning the distance-time curve of a Reach or Move element. When a distance-time

plot is made of the present Reach or Move data, a curve will result such as that shown in Figure 1.

Figure 1 shows a typical MTM data distance-time plot. The plot is curvilinear from distance A to distance B, distance A corresponding to the present MTM minimum distance of one inch and distance B corresponding to a distance of from 3 to 6 inches depending upon the particular case of Reach or Move involved. From distance B upward the plot is a straight line. This typical MTM data curve gives rise to two questions:

1) What happens to the curve below the present minimum distance of one inch? More specifically, does it continue down to zero time at zero distance as is indicated by the broken line?

2) Does the curve actually consist of a straight portion and a curved portion? Logic would seem to indicate that the distance-time curve of a motion would rise smoothly in one continuous curve as the distance of performance increases.

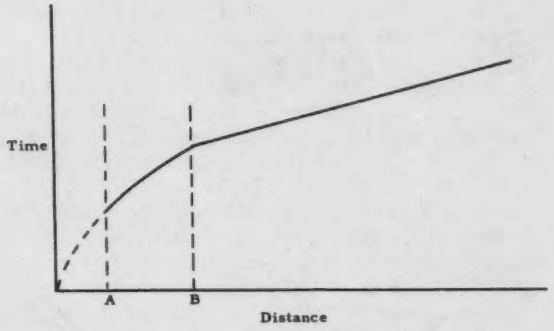

Fig. 1. Typical MTM Data Distance-Time Curve.

The analysis of research data has provided us with fairly complete answers to these questions.

Figure 2 shows the results of this analysis. Below a distance of one inch, the curve does not continue downward as indicated by the broken line but "levels off" to a relatively constant time value. The curve is shown dropping to zero only at the extreme left-hand limit of the chart. The drop has been exaggerated here for pictorial purposes. The actual performance times indicated by this "levelling off" process will be discussed in detail later. Further, the curve, as the distance increases, is shown increasing as a smooth curve without a "break" from curvilinear to linear. Research shows that such a smooth curve is the best representation of the behavior of motion data. This, however, does not mean that the straight line approximation is necessarily incorrect insofar as application is concerned. For

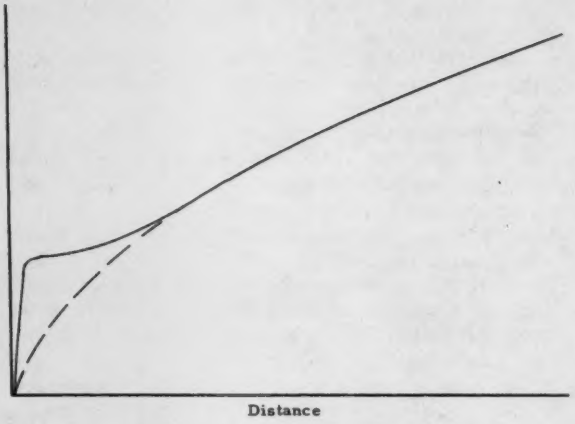

Fig. 2. Hypothetical Distance-Time Curve.

example, with Move, Case B, i.e., moves to an approximate or indefinite location, it was found that a smooth curve fitted the research data more accurately. However, when this smooth curve was compared to the present Move, Case B, curve, which is made up of a curved and a straight portion, the two curves differ from each other by less than .3 TMU at all distances from 3 inches upwards. From this it can be seen that though the data curve is probably curvilinear throughout, through the larger distances it is very close to being a straight line, so much so that using a straight line to approximate it would, in general, not be significant in terms of practical application. The two curves are compared in Figure 3.

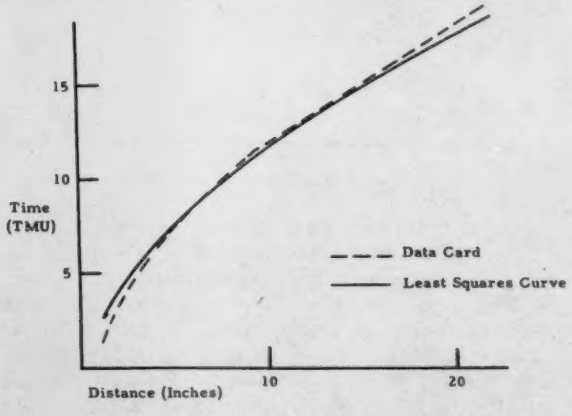

Fig. 3. Comparison of M-B Least Squares Curve and MTM Data Curve.

Thus, a typical distance-time curve of a given case of Reach or Move, shows a relatively constant time value up to a distance of approximately one inch and continues as a smooth curve with performance times increasing at a decreasing rate. This then represents the most correct general picture we have of a distance-time curve of a Reach or Move element.

Analysis at Distances Less Than One Inch

An investigation was made, then, into the performance times of motions in the distance range less than one inch, i.e., when the distance-time curve has "levelled off" to a relatively constant time value. Several important facts were uncovered. All cases of Reach and Move for which data were available indicated the same "levelling off" behavior. In addition, they all "levelled off" to performance times which were not significantly different from each other. In other words, as the distance of performance becomes small, all Reaches and Moves attain a point where all will require the same minimum performance time.

In Figure 4 we have this behavior represented graphically for the three cases of Move, A, B and C. Note that at the extremely small distances all three cases require the same performance time. As would be expected, as the distance increases, the case of high control, Case C, rises above this minimum time first followed by the medium control Case B and finally the low control Case A.

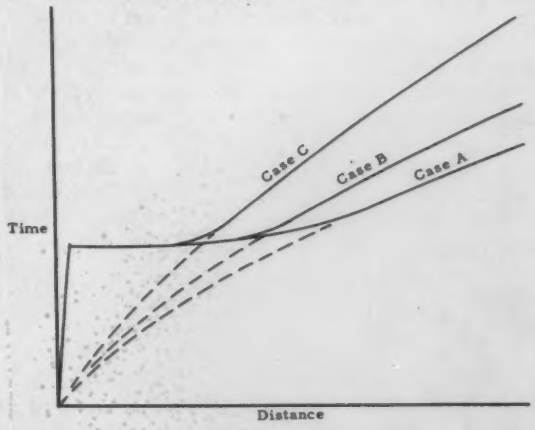

Fig. 4. Move Distance-Time Curves-Small Distances.

In a sense, what we have here is a physiological "floor" to performance times of hand motions. At very small distances, the characteristics of a motion no longer can determine its performance time. The basic physiological requirements for the human machine to function requires as much or more time than that required in the performance of the motion itself. In other words, the body's operation time "limits out" the motion performance time.

Thus, Reaches and Moves have a common minimum performance time which has been reached or very closely approached at distances less than one inch. This time has been found to be approximately 2.0 TMU. This value of 2.0 TMU represents a time value which can be applied effectively to motions which have distances of performance less than one inch. It is based on a considerable volume of research data collected from actual industrial operations. Proper use of it should increase the range and accuracy of MTM applications, especially to operations which contain extremely small finger and hand movements.

Analysis at Distances Greater Than One Inch

Following this analysis, a thorough study was made of performance times of Reaches and Moves in the 1 to 4 or 5 inch distance range. Close attention was paid to how well the research data could provide a reasonably correct time value at a given distance.

Through the use of statistical techniques, it was possible to determine, first, if the size of the research sample was sufficient to provide reasonable estimates of correct performance times, and second, if the present MTM application data were in need of revision. In several instances the research sample was shown to be adequate and, in addition, present MTM time values were indicated to be in need of correction. Therefore new performance times could be derived from the available research data.

In summary, the results were as follows:

Reach, Case A MTM data values were found to be too low at distances of 1, 2 and 3 inches. New values were derived for these distances.

Reach, Case B MTM data values were found to be increasing too rapidly at distances up to 4 inches. In addition, the present time value for a 1 inch R-B was found to be slightly lower than the time indicated by the research data. The Reach, Case B, distance-time curve should start at a higher time value and rise at a lower rate than is shown by a plot of the present MTM time values. New performance times for this element were also derived from the research data for distances of 1, 2, 3, and 4 inches.

Examination of these new time values for both Case A and Case B Reaches uncovered an interesting phenomenon. The new time values derived for Case A and Case B were very nearly the same.

In fact, the average difference between them at common distances was approximately .1 TMU. This difference indicates no practical significance between the performance times for Case A and Case B at 1, 2 and 3 inch distances. As a result, it will be found that new times values for Reach, Case A, and Reach, Case B, are the same for these distances. Beyond the 3 inch distance the distance-time curves separate with the Case B curve indicating greater performance times at the longer distances.

Reach, Case C and D, time values were in no way shown to require revision. The research data either supported the present values or provided only inconclusive results where they did not. The present MTM values were, therefore, left untouched.

Reach, Case E, and Move, Case A, time values likewise were found to be the best representation of the performance times of these elements in the short distance range. There was, however, one exception.

This was the performance time for these motions at the 1 inch distance. Both present values were found to be somewhat low. Therefore, new 1 inch performance times were derived from the research data for Reach, Case E, and Move, Case A, respectively.

Move, Case B, and Move, Case C, MTM time values were shown to be lower than they should be. Move, Case C, quite extensively, over a range from 1 to 6 inches; and Move, Case B, at 1 and 2 inch distances. New time values were derived for both these cases of Move.

The New Performance Time Values

Table 1 compares all these newly derived performance times with the present time values given on the MTM Application Data Card. This chart shows certain important facts. We see that all of the new time values for a 1 inch distance are greater than the minimum performance time of 2.0 TMU for these motions. The much lower 1 inch time values of the present MTM data are no doubt the result of a measuring unit which was too large. It could not detect accurately the actual performance times of these 1 inch motions, especially when the original data available at this distance were sparse. The more accurate measuring unit and the greater volume of data available in this research project indicates that these new 1 inch time values are better representations of the correct performance time. The same argument holds, of course, for time values derived for the other distances included in this table.

Dist.	R A		R-B		R-E		M A		M-B		M-C	
	New	Old	New	Old	New	Old	New	Old	New	Old	New	Old
1	2.5	*1.8*	2.5	*2.1*	2.4	*1.7*	2.5	*1.7*	2.9	*1.7*	3.4	*1.7*
2	4.0	*3.7*	4.0	*4.3*					4.6	*4.2*	5.2	*4.2*
3	5.3	*5.0*	5.3	*5.9*							6.7	*5.7*
4			6.4	*7.1*							8.0	*7.3*
5											9.2	*9.7*
6											10.3	*9.7*
7												*10.8*

Table 1. New Performance Times - One Inch and Above.

An additional point, which is not readily apparent from this table, is that all of these new time values, when plotted, will define a distance-time curve which will merge reasonably well with the present MTM Data distance-time curve.

These new time values, then, constitute possible adjustments of the present application data. With these, the data may become more nearly accurate and the motion descriptions of operations being studied by the MTM practitioner can more correctly portray what the operator is actually doing. The practitioner can only do this, however, by paying close attention to the small Reaches and Moves actually being performed in an operation. In many cases, the MTM practitioner, in using the present data, utilizes various "rules of thumb" to "cover" the areas in an operation involving short motions. These "rules of thumb," in general, will not work with these new time values. The new values must be applied, in most instances, to the actual motions being performed. This will necessitate greater care in determining, as closely as possible, the correct characteristics of the short distance elements and prevent reliance in the "rule of thumb" procedures.

In addition to these new time values for distance of 1 inch and greater, we have, of course, the performance time of 2.0 TMU for all Reaches and Moves less than 1 inch. When this time value was developed, the question arose concerning the validity of the time values for two other closely related elements; Release Load, Case 1, and the G1A or pick-up grasp. Both of these have time values of 1.7 TMU which contradict the minimum time of 2.0 TMU developed in this study. Further, these elements are considered at present as equivalent to a 1 inch Reach, Case E, and a 1 inch Reach, Case A, respectively. Both of these equivalent motions have present performance times of 1.7 and 1.8 TMU. As a result, both of these elements were investigated in order to check their performance times. Examination of the relevant data revealed two things.

1) The correct performance times of RL1 and G1A are actually 2.0 TMU or greater.

2) The equivalent motions are more accurately Reach, Case E, and Reach, Case A, both at distances less than 1 inch.

Thus, a greater amount of more accurate research data shows that what are essentially minimum motions of other basic MTM elements also have a minimum performance time of 2.0 TMU.

Motion	Time	
	New	Old
Reaches and Moves < 1 inch	2.0	-
RL1	2.0	*1.7*
G1A	2.0	*1.7*

Table 2. New Performance Times – Less Than One Inch.

Completing the list of new performance times indicated by the Short Reach and Move Project, we have the three shown on Table 2.

The Effect of the New Performance Times in Application

With all of these possible revisions of the MTM Application Data, what will be the effect on present and future time standards developed through MTM? The effect should not be too large, (1), because various "rules of thumb" have compensated for the inaccuracies of short element times, and (2), because, in general, extremely short distance elements constitute a very small portion of the average operation to which MTM is applied.

To check the effect of these new time values quantitatively, a random sample of thirty MTM studies used to determine production time standards was selected. All of these were made by MTM practitioners qualified by the MTM Association. They were studies made "in the field" of actual industrial operations. They, therefore, should constitute a reasonably valid sample.

In all 30 studies, the new time values were substituted for the present MTM values wherever the relevant motions occurred. The increases due to these substitutions were then analyzed. The results were as follows:

The percentage increase ranged from a minus .04 percent, i.e., a very small decrease, to a maximum of 4.16 percent or less than 5 percent. In addition, the average percentage increase of this sample was only 1.44 percent. Statistical analysis revealed, that, if the sample is a representative one, the probability is .995, or close to certainty that the average increase to be expected will be less than 1.97 percent. In other words, we can say that the expected average percentage increase due to the introduction of the new time values has a 99.5 percent chance of being less than 2 percent.

Obviously, the use of the new time values in the general run of MTM studies should not present a very difficult problem. In fact, the studies should be improved somewhat since the motion descriptions would be more nearly correct.

The Proper Use of the New Performance Times

However, the area in which the use of these new time values becomes critical is that of operations in which short Reaches and Moves predominate. In such operations the application of the new time values with present procedures would result in a very large increases in time unless care is taken as to how they are applied. The present "rules of thumb" and "motion equivalents" which are often used in studying such operations with the present MTM Data can not be used with the new time values. It is extremely important that these new values be applied to actual motions as they are observable when studying the operations and not to "motion equivalents" which merely "cover" or account for the time consumed. If these new values are applied correctly, two advantages should be attained:

1) The description of the motion sequences of the operation should present a truer picture, motionwise, of the operation.

2) A greater flexibility should result in determining accurate times for the motion sequences which make up the operation.

These advantages will be illustrated in the example which follows. This example, it must be understood, is somewhat artificial and is not an actual application of these new time values.

A common situation involving short Reaches and Moves is that of turning down a nut. Several "rules of thumb" are in present use which deal with this situation. Let us consider the situation where a medium size nut is being turned down. This is shown on Figure 5.

Old Method		New Method	
RL1	1.7	RL2	0
R1A	1.8	R2A	4.0
G1A	1.7	G5	0
M1B	1.7	M1B	2.9
	6.9 TMU		6.9 TMU

Fig. 5. Turning Down – Medium Size Nut.

On the left, under "old method" might be a motion sequence chosen by an MTM practitioner to describe this situation. It is, in fact, a motion sequence which has been used for this purpose. Note that in performing one turn of the nut four distinct motions are recorded as requiring time for performance. Actual film analysis of such a sequence indicates that the only motions to actually be observed are a Move and a Reach with the Reach being somewhat longer in distance than the Move. Using the new time values, the sequence might then more accurately be the one shown at the right under "new method." Here only the two motions directly observable as requiring time appear. The grasp and release elements are those which require no time for performance. They are included for completeness in describing the motion sequence. These two sequences exemplify the situation where the total time arrived at with the old values may be accurate but the motion sequence maybe somewhat inaccurate.

RL2	0
R<1A	2.0
G5	0
M<1B	2.0
	4.0 TMU

Fig. 6. Turning Down – Small Size Nut.

However, not only the motion sequence, but also the performance time may be incorrect. For instance, if the nut being turned is small, the motions involved may be less than 1 inch in performance distance. Under present procedures, the only motion sequence which can be used in the "rule of thumb" of the old method just shown, since there are no present

performance times for distances less than 1 inch. Using the new time values, a more accurate description of the motion sequence and a more accurate performance time might be found as shown on Figure 6.

As another instance, the nut being turned might be quite large with the following possible and more accurate motion sequences:

RL2	0	RL2	0
R2A	4.0	R3A	5.3
G5	0	G5	0
M2B	4.6	M2B	4.6
	8.6 TMU		9.9 TMU

Fig. 7. Turning Down – Large Size Nut.

Here we have two more motion sequences that would be determined by observing the actual motions performed. The old method "rule of thumb" would, of course, be inadequate here. Other "rule of thumb" sequences which might be used could roughly account for the time consumed, but, again, at the sacrifice of an accurate motion description and with the danger of providing too much time.

Thus, it can be seen that operations that contain predominately motions for which new time values have been suggested will require close attention to the exact motions being used. This is in order that the application of these new values will not result in large and erroneous increases in total time for an operation cycle. In addition, it should be pointed out that these new time values provide a more flexible means of handling situations involving large numbers of very short Reaches and Moves! They do so in terms of motion descriptions and in terms of the total performance times that they can provide. In general, accurate determination of the actual motions being used, with the new time values applied, will bring more accurate and meaningful results than will come from the blanket application of "rules of thumb."

This completes the summary of the short Reach and Move Project. It has not been possible to more than touch on the important results of this research. In order to gain a fuller and more complete understanding of the implications of this investigation, the report of this project published by the MTM Association should be studied in detail.

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APPLICATION

USING MTM FOR OPERATOR TRAINING

Robert Levin

Reprinted from the Second Annual International MTM Conference PROCEEDINGS, October, 1953.

Good afternoon, Gentlemen, and a hearty thank you for waiting around until this afternoon's speeches. Friday afternoon speakers always wonder if they have been chosen to speak last because the program committee wanted to get off to a fine start or — and this is what we would like to think — that our topic is of so much interest that the committee felt our speech would be the inducement for all of you to stay around until the end.

However it may be, I am sure that I can convince those of you who don't use MTM that it is the only training tool that gets sharper with use and for those of you already in the fold, perhaps I can open your eyes to some novel applications used in our factories.

United Mills was not the first needle trades plant to adopt MTM as an aid in method and rate setting. It took a lot of courage on our part to go into this program, especially when I tell you that one of the largest manufacturers in a competitive line had given their facilities for working up the original data on sewing and then chucked the whole deal. It made us wonder just what good would come of the program. Today, after almost two years of using it continually, I can give you the answer.

It saves TIME. It makes us MONEY. Typical American business reasons for undertaking any program.

Let me retrogress about three years and quickly sketch the events that led us to biting the MTM hook and how happy we have been since swallowing the bait.

Three years ago our management was faced with a happy dilemma. Our merchandise had caught the fancy of enough women's eyes (or perhaps it was you men) to warrant opening several new plants. Could we adequately staff it with trained supervisors and good sewers?

We told management to let growth come. Let the dam break with orders. Well, the dam broke, and through the breach came an avalanche of new styles, calls for faster, more accurate rate setting, training classes for new operators and so on. With a prayer on our lips, we started filling sandbags. Very soon, we were ham-hock high in water without a shovel. We had to be engineered so that we could at least fill sandbags or else we were going under.

There was one catch. None of us were engineers. Believe it or not, three years ago we had never taken a time study. My co-worker and I had been taught to set rates by the old method which goes like this; "HHHHHHHHMMMM, let's see. This job looks a lot like the other job, but the other job has an extra corner and pays ten cents. This doesn't have the corner but it has more distance to sew. Oh, hell, leave it at ten cents and pray." But since God only helps those who help themselves, we didn't get any relief from that end.

We did wise up, however, and hired a sewing engineer. He worked with us for three weeks and the old gray sage taught us the ancient secret of the Pharoahs — how to use the stop watch. Here was science personified. Here was progress just for 150 bucks a day and expenses. All you had to do was to hide behind a post, put the watch in your pocket, press the little button on top whenever the operator started, and press it again when they stopped. Then run back into your office, divide the time in half, and that's your rate. Would you believe it? In two months I wore out pockets in three pairs of pants setting rates by this method.

The irony of it all is that we would still be using that method today if the damn fool hadn't told us to cut the time in half instead of 80 percent which it really was.

Naturally, the rates were incorrect and the method was not recorded so that the entire price structure was "loose." We had to constantly adjust standards to compensate for the fact that operations which were done intermittantly and against which we had no check for a long production run, suddenly became everyday jobs and the operators ran away with the prices.

We were hitting people in the one spot that hurts the most — their pocketbook. And some of those nice old Southern ladies that you read about told me in plain Rebel talk that unless we quit messin' with their pocketbook, there'd be more hell raised than a little bit.

It didn't take much to read the "scrawl on the wall" and we had to do something to erase the black and blue marks against our name, caused when two untrained technicians ran headlong into new brick buildings with lots of new help and plenty of unfilled orders.

It was perfectly clear. We needed more supervisors. Training these supervisors is a problem that we haven't licked yet. We hired men who didn't know a bra from a pair of ear muffs. And now, since the bras come padded — and wired on top of that — all of the newer boys are more confused than ever. But that's a research problem and not one to discuss here.

We needed qualified help to aid us in controlling this expansion splurge. We advertised for and hired two industrial engineering graduates. Now . . . We were scientific. Education at our beck and call. Degrees hung on the wall, charts in their notebooks,

and the key to the mystic wonders of the Far East — the Lowry system of rating. But since all of us interpreted Mr. Lowry in our own way we soon cooked a bigger stew than we could eat.

It was then that I attended my first conference and found out about MTM. At last, here was a true method to this madness of rate setting. Home we would go and sign up for an eight weeks' course which would be attended by everyone who could crowd in the classroom. We had it now. Scientifically set rates which embodied the cumulative thinking of thousands of engineers who had squinted at millions of feet of film taken at all kind of frames to the second. We really snowed our management.

We convinced them that rate setting could be for the masses. No more adjustments in rates. Set them one time and let them sew like mad. The book says that rates can't be beat by much more than 20 percent. But the book also says — and in much, much larger letters — that the proper method must first be established.

In two years we haven't got much further than that one sentence.

We use MTM to determine the correct method. The price per dozen is a by-product of the methods department work. After all, if you mix all the correct ingredients in baking, it's very logical to assume that you'll have a cake if you apply enough heat. We apply heat from two different ends:

1. Training new operators quickly and correctly.
2. Retraining old operators.

Before we could do any training we had to have the one best method. That meant assigning our best MTM students to the newly created Methods and Standards department and giving them our two most promising floorladies. These were women who knew how to perform every operation and who were on our side in that they realized that this search for the best method was not wasted money, but good ole' Southern mule sense. Both these women had taken the MTM appreciation course and had shown a clearly discernable liking for this type of work.

We sat our newly created staff in a special room equipped with sewing machines, a blackboard, plenty of writing room, gave them two clerks to do their filing and figuring, and also gave them explicit instructions to go over our basic operations with detailed care. They were to work out an infinite number of methods until they were positive that each regrasp, each hesitation, each realignment; in fact, each stitch — was as necessary as putting in your teeth before eating steak. We made them swear on the family Bible that each inch of reach and move represented the shortest distance between cloth and needle.

You might say that they were writing the textbook of sewing. The primer which we would use for both trainee and retrainee. They wrote it the best way they knew. For all I know, many of the operations can be done more efficiently but at that time, their work was a big step forward in cost reduction and its pleasant taste is still felt in management's mouth. When time permits, we shall send them back over the operations with a finer tooth comb in an effort to save more minutes, but this program must wait its turn.

All this staff was pulling down some weekly payroll and it wasn't long before our non-technical management asked if the end justified the means? But since we were about to begin adding nearly 500 new sewers within 15 months, we easily showed them that the expected savings in training time would more than pay for a staff four times this size. Perhaps our figures were not exactly true, but a few small lies never hurt, especially if you're dealing with a management that is slow to grasp the merit of technical advances. In our hearts we knew that the results would change our entire training procedure and greatly reduce unit costs, so we fibbed and crossed our fingers many times before we finished our project.

We took each of the new studies on our basic operations and analyzed them carefully. One point stood out that scared us. We discovered that the machine was actually in motion about 35 percent of the day. The remaining time was being spent in reaches, moves, grasps, cutting, writing, tearing, tying, bundling, and just about every handling element that you could name. We had to get the needle to turn out more stitches, for in our business stitches mean work, work means shipments, shipments mean money, and money means better salaries, and salaries are something I work for no matter what the human relations boys tell you about it being third or fourth on the list of factors that motivate people to work.

Since handling time was so great — even after our Methods staff had refined the operations — it was logical to assume that it was taking the greater part of training time. And yet, all of us were positive that it was the one feature that should be mastered in the shortest period.

We had plenty of proof for this assumption. Operations in the factory that were non-machine and all handling — such as boxing and folding — were constantly being mastered in a very few weeks, but even the simplest machine job was taking months before standard was attained.

Consider, if you will, the happy hours spent teaching your wife to drive. Wasn't it wonderful how she learned to shift gears when the car was standing in the garage? But get it moving on the loneliest of roads and you had another Lucky Teter on your hands. The handling was simple but it's the machine time that drives 'em nuts.

It's the same with sewing. Handling time has to be learned quickly and is the one feature of the work that we insist new operators perform at standard times no matter how slowly or poorly they drive the needle during the sewing cycle.

We believe that anyone who is coordinated can

learn to pick up two pieces of cloth and position them to the needle quickly.

Let me put it this way:

How many of you have gone out to the golf course and watched a well-dressed golfer with a fine set of clubs come out to the tee, look over the course, pull out his driver, tee up a new ball, waggle the club several very efficient looking times, and then miss "hell" out of the ball. Your first reaction is, "Well, he sure looks like a golfer." And you're right. He did everything fine and fast except getting the ball off the tee. The same way with sewing. We want our girls to look like sewers in their handling. We know that the machine time is done in short runs until they gain confidence, but the handling should be done with finesse and smoothness. There is no reason in the world why a trainee who possesses normal coordination should not be expected to reach for the work, pick it up, move it to her other hand or the machine, align it with something else, and put in position to the needle in standard time. And yet, this is the phase of work that is sadly neglected and one in which more learning time is lost than any other factor. Since handling time is twice as much as machine time, twice as much of our attention goes into teaching new operators to handle work efficiently.

I think you will agree with me when I say there is nothing so sickening as walking through the factory and seeing new employees cutting or stacking or reaching like they were old women. I don't care a hoot if they can't sew fast – that will come – but there's no law in my book that says they can't move fast.

Now all of us are ready to go through the operator training program as followed at United Mills.

You must agree with our thinking that since handling time takes the majority of the day's minutes, it must be given the most attention in the training room. In handling, you have the greatest application of MTM. I have yet to see just how much help MTM gives you after you get all the pieces lined up and press your foot down. Machine time has always been taken from a table and goes back to the basic problems of speeds and feeds. But, oh brother, you can't realize the many different methods that can and are used to ready the work for the machine cycle. This applies to drill press work just as much as it does to sewing.

Our problem with operators is teaching them handling. It's a sales problem. That's all it is. A-SALES-PROBLEM.

We have to convince new employees that we don't need a watch to tell how much work should be done in a day's time. Since the tool is so new, very few of our employees have ever worked in a factory where someone comes by to set a rate by standing there with a ruler and pencil rather than a watch.

What more logical way to convince them that the watch is out than to explain in great but simple detail that there is one best way to do things. We ask each of them to show us how they would deal cards. Invariably, all of them deal the same way. The employee deals as fast as she can and we clock her, then our floorlady deals the MTM method and the analogy is gotten across without any further explanation. A better method of handling.

Then we ask them to deal the cards their own way but to take longer moves before depositing the cards in the four piles. Here again, they see by the stop watch that it took longer even though they did speed up the deal. Why did it take longer, we ask. And the answer comes back like thunder 'cross the bay – "Because you made me reach longer."

That's your answer. You reached longer, so it took longer. And if you reach longer on the sewing floor, it will also take you longer. And if it takes you longer, you won't earn your minutes, and if you don't earn your minutes, you won't have a job. Not quite as hard boiled as that but that's the general sequence of questions and answers.

Their next question is "But how can you expect me to earn minutes if I am just beginning?"

Now is your chance to hit them with the loaded barrel. They are standing there with your guard down. Just how can we expect them to earn minutes if they just walked in the factory?

MTM. The correct method. If you follow the correct method you will meet our standards. "But even if I follow the method, don't you give me time to pick up speed?" It is at this point that the floorlady gets into the meat of the training problem.

Our training floorlady takes the girls to a machine in the room which is set up exactly as they are on the sewing floor and demonstrates by doing a very simple operation just how little time is spent in maneuvering the work while the needle is moving as against the time spent getting ready to perform the sewing cycle.

She explains to them all the many extraneous elements that must be done in standard time if production is ever to be made. The trainee is made to realize that even tying and untying the bundle, writing on her work ticket, pasting and tearing of the work ticket, all take time and are all figured in the standard and all must be done quickly if standard is ever to be reached.

We convince trainees that since handling takes 60 percent of their time then we expect to see 60 percent of standard earned the very first day they are on the floor. We do not count in any machine time. We figure that the 10 percent they usually earn on machine time is lost in their not performing the entire handling procedure at the proper pace. After all, trainees are still human.

The important point for management to realize is that if work is handled properly there will be more time for sewing or whatever machine cycle you are working with. Since anywhere from 40% - 60% of our jobs are handling times we are at least assured that trainees' labor loss will not exceed the difference

between those figures and 100 percent.

We begin with the simplest of operations. One pile of cloth on the left and one pile on the right. The trainee is shown the proper method for reaching, grasping and moving the cloth to the table area. Nothing else. We allow the trainee to practice the method for 15 minutes. Then we give them a stack of 72 pieces (our bundles are six dozen), start the watch, while the training floorlady stands in back and watches to see if the method is being followed. The same time is used as if this were a productive job on the floor and we have had but a bare scraping of new employees to fail the first part of their training test.

If anyone fails to beat standard, it is usually caused by nervousness and a second or third try always ends in success. If subsequent tries are failures we have spent but very little money to weed out a sub-standard employee.

Now the floorlady stops and congratulates the girl for doing the operation just as fast as girls out on the floor who have been here for years. The use of MTM standards insures a passing test grade.

The second operation consists of reaching to the cloth, grasping, moving to the table area in front of the needle and aligning as in the first phase, but now we bring in the element of raising the pressure foot while the hands are in motion. This takes the same amount of time, but calls for a little more coordination.

We explain that although they are doing more, we do not give them more time because the pressure foot is raised while they are doing something else. You and I call it simultaneous motions. You see, we are giving them an insight on MTM rate setting. Again the time is recorded to do a six dozen bundle and again the operator is complimented. This must be done, for it gives the new employee a sense of achievement and makes her wonder if sewing is as difficult as she thought it would be. But you and I know that she's still handling and actually not sewing a stitch.

The third test operation is an amplification of the first two. The work is brought to the needle area, positioned, the foot lowered, and the operator presses down on the treadle as if she were going to tack, but of course there is no power. A few tries and this can be performed very creditably and with lots of finesse by the newest employees.

The last handling test is to perform the above operation, but after the make believe tack, slide the hands to the ends of the cloth, realign, and press the pedal as if to sew the seam. Still with no power but always timed and always with the trainees meeting or beating our standard. Earning production the very first morning as it were. At least, that's what we impress on the trainee. They are doing as well or better than many of our girls who have been sewing since the plant opened. You see, everyone likes to have a goal to shoot at and this applies especially to beginners. Just like golf. First you try to break a hundred, then ninety, and then you buy a book on "How to Play Par Golf" and you go back to a hundred again.

While these tests are being run the floorlady points out to the trainee that everytime we have added something to her work, she had been given more time to perform the operation. This familiarizes them with our rate setting procedure and makes them cognizant of the fact that we pay in minutes and not in money.

If the trainee has passed the first section of the test she is considered a good prospect and allowed to continue with the course. We have found that we can weed out about 12 percent of all applicants in the first three hours of employment and this is a much better arrangement than all the dexterity tests in the world. No wasted money with girls who can't reach, pick up, and move. After all, that's the basis of all our sewing and we have every right to insist that it be passed with flying colors.

Now is the time for sewing. The operator is taught the mechanics of the machine — stop, start, handwheel turns, etc. But we don't thread the machine. No sense to worry them with something that can be learned in a matter of minutes. Anyone who can handle work can be taught to thread a machine. That comes last with us.

We give each trainee plenty of sheets of stiff brown paper. She is given instruction in handling the paper while the machine is in motion and allowed about an hour to mess around — so to speak. The floorlady corrects any bad habits while they are gaining machine confidence. This takes up the remainder of the first day.

Money is paid out, no work turned in, but a trainee who is a good bet to make standard.

The second day starts with the handling tests again and then more practice with the brown paper.

Now comes the second part of the test. 72 pieces of this brown paper are placed in the work area and the trainee reaches, grasps, picks up, moves, positions, and sews down through the lines marked on every piece. Your eyes would open if you could see just how well they mastered the machine. Although they usually start out a little rough, they actually look like experienced sewers by the time they get one-third through this test and towards the end they fairly fly with the handling.

Whoever passes this test, and about 90 percent always do, is taught how to thread the machine and allowed to practice.

Now similar sheets of brown paper are given out with two vertical lines down the center a half inch apart. The operator must pick up the paper, sew down through the lines, pull out the work from behind the needle, reach for another, and so on. She is taught how to pull the work back across her table, snip it properly, and stack and count.

We impress on them that all work must be counted. The first bundle they do has about 68 pieces in it and we check to see how many they claim to have cut when

they finish the bundle. If the thread breaks while they are sewing, naturally, they stop and rethread. We have already explained to them that sufficient time is given for thread breaks in all our studies. We also impress on them that they won't make standard on this test unless they pull across quickly, snip quickly, and stack quickly.

This ends the second day. Still money paid out and no work coming back in.

The third day we give them general instructions in doing the same maneuvers with cloth instead of paper. Then they are sent to the sewing floor, after practicing cutting off work tickets, etc.

They approach the sewing floor with confidence. They have been taught and can perform every basic handling motion we need to do our work. There is no reason why they won't go on to make good sewers.

Now that we have them out on the sewing floor they are assigned to a permanent job and put into training. How can we tell exactly how long it should take to make standard on each operation? Again we used MTM.

We went back to the analysis sheet and gave all the machine time elements three times their normal time value. We added to this the actual handling time and plotted this on a curve. Again you see that we consider handling time as something that anyone can master, but we admit that dexterity with machine time is slow in coming.

The curve we use is the one which was taken from any standard book of industrial engineering. It is the universal training curve for all learners. The horizontal measurement is in TMU's and the vertical measures the weeks.

It is very logical to assume that this figure will vary in different industries and I imagine that a wealth of research time could be applied against this problem. We hit ours right on the head and are perfectly willing to accept it as Gospel. Our training curves substantiate our findings and since we have over 400 completed curves in our files, it will take an awful lot of strong argument to dissuade us.

I can also tell you briefly that we believe that MTM can be used to grade sewing jobs as to complexity. We are assigning so many points to each reach and move, so many more to each grasp and regrasp, so many to each simple position, and the largest amounts of points to the difficult positions. The more points, the higher job grade the operation receives.

Perhaps I may be able to tell you more about this at a later date. Again I would welcome correspondence if any of you are on the same tack.

Since we had qualified trainees on the sewing floor, and knew just how long it should take to learn the operation, we could easily set up a training schedule which would warn our new plant managers if operators were not coming along at the correct learning rate. We used the identical training curve and plotted weeks on the horizontal against minutes on the vertical. Daily earnings were posted and the trainee could earn a production bonus if her earned minutes at the end of the week were above what was considered normal for a trainee at her stage of the training period.

Turnover dropped sharply. We could weed out the weak sisters without waiting too many weeks, could shift them to an easier job and watch their progress again, could accurately tell just about when a section would get up to standard, and no longer had to rely on the floorladies to judge the potential worth of a new machine operator. Either she was above the training line or she wasn't. If she was, our labor loss was nothing to be frightened by. If she was below the curve, we dismissed her or transferred her to a less skilled job and saved all that salary that is usually put out during the decision period when you and the supervisors are deciding who stays and who goes.

Furthermore, the same system of trainee bonus pay is used for retraining the old operators on new jobs. In this case, employees get only half the training time and we have found that it works out perfectly. We don't guarantee wages when we transfer operators to new jobs, don't get excuses when we ask them to transfer, and don't have the problem of make-up pay for an unfair period of retraining time. Each employee takes a special pride in the fact that she is earning above trainee standard.

Furthermore, we make it mandatory for the plant manager to notify each operator on Monday what her goal in minutes or dozens is for that week. That gives them some definite goal to aim at from the very first minute of work.

But teaching an old dog new tricks still is as difficult today as it was when the saying was inspired. Resistance to change, a reluctance to try our method, call it anything you wish — is very strong in the Southern country women. "Ah bin doin' right well this a way and don't reckon hit's any sense to my changin' now," is the answer you can expect to get from any of them. So we went back to hitting them where it hurts the most – in their pocketbook. They can have their choice. 1. We will guarantee pay for a specified period of weeks if they will go back in the training room and master the new method, or 2. We will put in the new rate which reflects the method change immediately and they can sweat it out themselves. Failure to make production standards will result in a transfer to a lower grade job. We don't put it to them so harshly but the end result means exactly what I said.

In order to show them just how much money they are missing by refusing to learn our new method we prepared charts showing the value in money for each incorrectly performed motion, each extra foot motion, each regrasp, each hesitation, etc. These charts are nothing but the value of a TMU in each of our eight job grades. And the TMU's run from 100 to ten million so that we can cover just about any extra

amount of motions that we notice on the floor.

We shy away from mentioning the savings in money but make an effort to convert the money lost into something tangible such as a ticket to the movie, ten pounds of chicken feed, a new plot point, and so on.

When you tell a woman in our town that just by doing less work in the form of less motions that she actually will earn more money — well, the psychology is terrific. It's a fabulous approach.

Training operators — either old or new — is the most important phase of our business. And we have conclusively found that by teaching all the simplified motions until they can be performed in the regulation time that our training period has been reduced by over half. The acquisition of the basic handling skills in the training room enables the recruit to master the job quickly, in that she has already been keeping time with the tempo, rhythm and movements of experienced operators.

One of the more important aspects in training operators is reduction of turnover. When a newcomer to industry is able to acquire mastery of her job in a relatively short time she will be able to settle down to the business of earning the company money fairly easy. However, if it is going to take six months or more (as many of our jobs used to) it is truism to expect turnover to stay high. The new employee attempts to ease the pain of a lengthy training period by occasionally absenting herself and then — especially if the plateau period is long — she eventually leaves. We have an absentee record of 3 1/2 percent for trainees and a turnover rate of almost nothing.

Our trainees don't follow the industry old practice of learning slowly. We teach them how to do everything fast right from the very first day. They have learned their job motion by motion. The stitch by stitch comes on the sewing floor. When a trainee sees just how close she can come to making standard merely by working on the sewing cycle — it isn't long before we have another qualified sewer.

The operator is happy, the floorlady is happy, the manager is happy, the top management group is happy, and I can uncross my fingers and quit telling little white lies.

What more can I ask for???

* *** *

MTM in Whaling Industry. The use of MTM to establish time standards for cutting up whales is one of the more unusual applications reported recently.

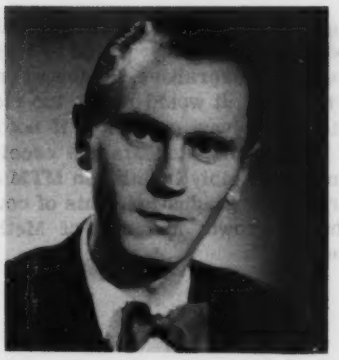
> When an Australian whaling outfit wanted a time study of the activities aboard a processing ship, a Sydney consulting firm did it with MTM. A qualified MTM man and movie photographer went with the whalers to study the operations and take movies as a whale was caught, inflated and taken to the factory boat where it was cut up for reduction to oil, meat, bone and solubles. Some of the cutting was with power saws.
>
> With the personal observation and study of the pictures, a report was made on time standards and methods which the company considered of great value.

MTM NEWS

The March 1 Board of Directors meeting was held at the Michigan Union on the campus of the University in Ann Arbor. Members of the University staff were luncheon guests of the Association at this meeting. This gave the Board an opportunity to meet staff members of the University who are in contact with the MTM Research Program.

The following photo was taken at the March 1 luncheon:

Standing: Left to Right — Richard F. Stoll, Executive Secretary, MTM Association; David L. Raphael, Research Associate, University of Michigan; James Thompson, Chief Industrial Engineer, Argus Cameras, Inc., Ann Arbor, Mich.; Dr. Richard G. Folsom, Director, Engineering Research Institute, University of Michigan; Seth L. Winslow, Vice President, A. T. Kearney & Company, Chicago, Ill.; Prof. Harry J. Loberg, Director, Sibley School of Mechanical Engineering, Cornell University, Ithaca, N. Y.; Prof. Edward T. Vincent, Chairman of the Department of Mechanical and Industrial Engineering, University of Michigan; William Thompson, Supervisor of Standards, Argus Cameras, Inc., Ann Arbor, Michigan; Dr. Charles B. Gordy, Director of MTM Research and Professor of Industrial Engineering, University of Michigan; Edward Barnett, Works Manager, Binks Manufacturing Co., Chicago, Ill.: Seated: Mrs. Mary Hendricks, Secretary, MTM Association; C. E. Taylor, representing Fansteel Corp.; Robert Hamman, Partner, A. T. Kearney & Company, Chicago 3, Ill.; Dr. George Granger Brown, Dean of College of Engineering, University of Michigan; William Hodson, Vice President, Methods Engineering Council, Pittsburgh, Pa.; Robert C. Rick, Industrial Engineer, A. T. Kearney & Company, Chicago, Ill.; P. McLaren Pardew, representing Glenn L. Martin Aircraft, Baltimore, Md.; Prof. Bert Steffy, Mechanical and Industrial Engineering, University of Michigan.



Mr. Lars-Erik Fahlin, Chief Industrial Engineer for the Directorate of Swedish National Defense Factories arrived in the United States early in February to study the present position of the MTM System in American industries and in colleges. Mr. Fahlin has visited the Executive Offices of the Association as well as the research facilities at the University of Michigan in Ann Arbor.

He has also visited a number of industrial companies who utilize MTM in order to ascertain a cross section of MTM Applications.

The purpose of this investigation is to provide sufficient information to permit Mr. Fahlin to write a report on MTM to be presented sometime this year to the Royal Academy of Engineering Sciences in Sweden. This report should have a definite effect on the growth and development of MTM in Sweden.

We wish Lars-Erik Fahlin well in his endeavors.

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MTM AT COLLEGES AND UNIVERSITIES

Recently, the MTM Association completed a survey of colleges and universities inquiring into the extent to which MTM has become a part of the Industrial Engineering or Management curriculum. The results show an interesting growth and acceptance of MTM.

Of the questionnaires sent out, 29 replies were received. As there are only slightly more than sixty schools offering curricula in Industrial, Management or Administrative Engineering, this represents a response only a little under fifty percent of the possible responses, and is large enough to lend some weight to the information contained therein.

Of the responding schools, 93.1 percent indicated that MTM was in some way part of their curricula. The breakdown in terms of the extent that MTM is included is as follows:

As a separate course of study	17.2 percent
As part of a more general course	79.3 "
As an informal lecture or discussion	17.2 "
As a clinic or conference	17.2 "

The most widespread use of MTM was as part of a more general course of study. An interesting point is the fact that MTM was usually discussed in these courses along with the general subject of Standard Data and usually one or two other predetermined motion time systems. The significant point is that no other system was as consistently included as MTM. Eight other systems were discussed, spread over 23 different schools, one or two to each school, while MTM was discussed in all 23. In addition, 17.2 percent reported separate courses in MTM or in which MTM was the predominate subject. No school indicated similar courses in any other system.

Following is a breakdown showing the average number of hours spent on MTM in these courses and also the range of hours.

	Average	Range
As a separate course	47 hrs.	36 to 60 hrs.
As part of a general course	20.1 hrs.	5 to 39 hrs.
As an informal lecture or discussion	1.2 hrs.	1 to 2 hrs.
As a clinic or conference	29.8 hrs.	3 to 66 hrs.

It is important to remember that the number of hours listed for regular courses refers to classroom hours and does not usually include homework or laboratory work. This breakdown indicates that the student is receiving a considerable amount of orientation in MTM principles, more than would be expected on a purely appreciation level. In fact, the consensus of schools replying was that the student is achieving a competence great enough to make some immediate use of his knowledge of MTM, at least in the various applications to methods work. None of the schools, however, claimed that their students were completely trained in MTM, but, in varying degrees, were given a thorough academic introduction to it.

What then are the numbers of people being reached by this program in the colleges and universities? Following is a listing in terms of the average number of students reached and the range of the number of students in each category.

	Average	Range
As a separate course	15	8 to 20
As part of a general course	45.2	10 to 120
As an informal lecture or discussion	86	19 to 200
As a clinic or conference	74	10 to 183

The total of all persons participating in these activities was 1739 persons, a considerable number considering the relatively short time that MTM has been in existence. In addition, considering the fact that less than half of the possible schools have responded in this survey and that all the colleges and universities having an Industrial Engineering or related curriculum have only a reported 5226 students, both undergraduate and graduate, the figure of 1739 persons reached during the period covered by the survey is quite large. The figures of the survey refer to a period of roughly one year and to less than half the colleges and universities. Students remain so for four to five years. It would not be too ridiculous to hypothecate that a vast majority, if not nearly all, Industrial Engineering students are receiving some orientation and possibly training in MTM on a small scale prior to their graduation. This of course points to a continuing growth and use of Methods-Time Measurement.

RESEARCH REPORTS

Disengage (Report 101)

This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

Reading Operations (Report 102)

The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

MTM Analysis of Performance Rating Systems (Report 104)

A talk presented at the SAM - ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

Simultaneous Motions (Report 105)

This report represents almost two man-years' work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

Short Reaches and Moves (Report 106)

This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

OCTOBER 1954

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R E S E R V E

These Dates in '54
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Third Annual

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- REGULAR TECHNICAL SESSIONS OCT. 7 and 8. LATEST DEVELOPMENTS IN MTM
- INTRODUCTORY APPRECIATION SESSIONS OCT. 6, INFORMATIVE PROGRAM ON BACKGROUND OF MTM